General

Guideline Title

ACR Appropriateness Criteria® suspected infective endocarditis.

Bibliographic Source(s)

Hsu JY, Malik SB, Abbara S, Akers SR, Araoz PA, Cummings KW, Cury RC, Dorbala S, Earls JP, Hoffmann U, Jacobs JE, Min JK, Woodard PK, Expert Panel on Cardiac Imaging. ACR Appropriateness CriteriaÂ® suspected infective endocarditis [online publication]. Reston (VA): American College of Radiology (ACR); 2014. 8 p. [42 references]

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Schoepf UJ, White RD, Woodard PK, Carr JJ, Dorbala S, Earls JP, Hendel RC, Ho VB, Hoffman U, Mammen L, Ryan T, White CS, Expert Panel on Cardiac Imaging. ACR Appropriateness Criteria® suspected infective endocarditis. [online publication]. Reston (VA): American College of Radiology (ACR); 2011. 6 p. [48 references]

Recommendations

Major Recommendations

ACR Appropriateness Criteria®

Clinical Condition: Suspected Infective Endocarditis

Radiologic Procedure	Rating	Comments	RRL*
US echocardiography transthoracic resting	9	This is the preferred modality.	O
X-ray chest	8	This procedure is useful for monitoring cardiopulmonary status.	
US echocardiography transesophageal	8	This invasive procedure is used when better definition of anatomy is required.	O
Cardiac function and morphology with contrast	6	This procedure is used mainly in the setting of suspected paravalvular infections and to evaluate	

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level

Radiologic Procedure	Rating	Comments	RRL*
		prosthetic heart valves.	
MRI heart function and morphology without contrast	6	This procedure is used mainly in the setting of suspected complications and for quantifying the volume of valvular regurgitation.	O
MRI heart function and morphology without and with contrast	6	This procedure is used mainly in the setting of suspected complications and for quantifying the volume of valvular regurgitation. See statement regarding contrast in text under "Anticipated Exceptions."	O
CT chest with contrast	5	This procedure can be helpful to evaluate pulmonary findings such as septic infarcts.	
CTA coronary arteries with contrast	5	This procedure is used mainly for better definition of coronary artery origin and course prior to surgery.	
Arteriography coronary with ventriculography	5	This procedure is used mainly for evaluation of coronary artery disease prior to surgery.	
FDG-PET/CT skull base to mid-thigh	5	This procedure may be particularly useful in suspected prosthetic valve endocarditis.	
In-111 WBC scan heart	3	This procedure has largely been replaced by cross-sectional imaging techniques.	
Fluoroscopy heart	3	This procedure has largely been replaced by ECG-gated CTA. It may be considered for initial evaluation of prosthetic heart valves.	
CT chest without and with contrast	2	Noncontrast CT chest adds radiation without clear benefits.	
CT chest without contrast	1	This procedure cannot be used to evaluate vascular structures for complications.	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Note: Abbreviations used in the table are listed at the end of the "Major Recommendations" field.

Summary of Literature Review

Introduction/Background

Infective endocarditis can involve a normal, abnormal, or prosthetic cardiac valve. In recent years, infective endocarditis of normal right-sided valves has become more frequent as a consequence of intravenous (IV) injection of illicit drugs, indwelling IV catheters, and implantable cardiac

devices. Although acute endocarditis of left-sided cardiac valves nearly invariably causes congestive heart failure, heart failure may also occur with subacute infective endocarditis. Physical examination typically reveals a new heart murmur. The diagnostic workup of patients with suspected infective endocarditis typically includes serial blood cultures and echocardiography.

Infective endocarditis is fundamentally a clinical diagnosis based on the presence of positive blood cultures in association with characteristic symptoms and physical findings. Blood cultures may be negative in the setting of antibiotic use. Imaging is used to support the diagnosis by demonstration of vegetations of cardiac valves and, in complicated cases, paravalvular abscesses affecting native and prosthetic valves. Imaging is also used to assess the severity of valvular damage, identify complications, and recognize the presence and severity of heart failure.

Chest Radiograph

The chest radiograph is used to determine cardiac chamber size and the presence and severity of pulmonary venous hypertension and edema; it is necessary for the evaluation of infective endocarditis. It is used to monitor the severity of the hemodynamic consequences of valvular regurgitation caused by infective endocarditis and to assess their response to treatment. In right-sided endocarditis the chest radiograph is effective for demonstrating pulmonary infarcts and abscesses as sequelae of septic emboli.

Transthoracic and Transesophageal Echocardiography

Transthoracic echocardiography (TTE) plays an important role in the evaluation of infective endocarditis and is currently the only imaging criterion included in the modified Duke criterion used for a diagnosis of infective endocarditis. It can demonstrate vegetations on cardiac valves, valvular regurgitation, and paravalvular abscess. It is the most frequently used imaging study for confirming the diagnosis of infective endocarditis. The demonstration of vegetations by echocardiography is 1 of the 2 major modified Duke criteria required for the diagnosis of a definite endocarditis.

Studies show that criteria for the diagnosis, which include the findings on TTE and particularly transesophageal echocardiography (TEE), were significantly better than traditional criteria based on clinical and bacteriologic criteria. Although TEE has been shown to have significantly higher sensitivity than TTE for identifying vegetations, specificities were similar. The positive predictive value of TTE for the diagnosis has been shown to be 97%, whereas the negative predictive value was 94%.

Several studies evaluated the diagnostic value of TTE and TEE in relation to the pretest probability of infective endocarditis based on clinical assessment in pediatric and adult patients. These studies concluded that echocardiography has a lower yield in patients with low probability of endocarditis. TEE is the procedure of choice for patients with intermediate or high probability of endocarditis. In right-sided endocarditis, TTE and TEE performed comparably, demonstrating a similar number of vegetations and frequency of tricuspid regurgitation.

The size and other characteristics of vegetations on echocardiography have been shown to be useful in predicting complications such as peripheral embolization. Increase or failure to decrease in size of vegetation on serial echocardiograms during antibiotic therapy has been shown to be predictive of a prolonged and/or complicated course of infective endocarditis.

TEE is indicated and increasingly used in suspected infective endocarditis for demonstrating vegetations, paravalvular abscess, and valvular regurgitation. It is the most sensitive imaging technique for identifying vegetations, the presence of which is the hallmark for the definitive diagnosis of infective endocarditis. Using criteria for diagnosing infective endocarditis based on echocardiographic features provides better diagnostic accuracy than using clinical criteria alone. TEE has better sensitivity than TTE for detecting vegetations. Authors of a review claimed that in experienced hands, TEE has >90% sensitivity and specificity for detecting intracardiac lesions associated with infective endocarditis. This and another review also concluded that a negative TEE almost always means a very low probability of infective endocarditis.

TEE has been shown to be very effective for monitoring the size and other characteristics of vegetation and for detecting complications such as paravalvular abscesses. TEE has better sensitivity and accuracy than TTE for identifying paravalvular abscesses. TEE is indicated for suspected infective endocarditis of prosthetic valves; it is significantly more accurate than TTE. Furthermore, monitoring the size of vegetations during treatment contributes information concerning prognosis and risk of complications, although the usefulness of repeated TTE for altering patient management decreases with the number of repetitions.

TTE was found to be the more cost-effective test in patients with intermediate or high pretest probability of infective endocarditis.

TEE is indicated in many patients with suspected infective endocarditis, especially those in whom TTE is inconclusive or those with suspected paravalvular abscess.

If the initial echo is negative and the clinical suspicion is high or if the pathogen is a virulent organism such as *Staphylococcus aureus*, a repeat TTE in 7 to 10 days may be considered. This follow-up study can in some instances be a TEE study (especially if the quality of the TTE is not optimal).

Radioisotope Scanning

Although largely replaced by cross-sectional imaging techniques in clinical practice, radioisotope scanning may be used in some instances in the evaluation of suspected infective endocarditis. Several types of radioisotope scans may be used for identifying and localizing infected vegetations and paravalvular abscesses, such as gallium-67- and indium-111-labeled white cells. Although these techniques are useful in isolated patients, they have a low sensitivity and add little to the usual diagnosis of infective endocarditis.

Immunoscintigraphy using technetium-99m-labeled anti-NCA-95 antigranulocyte antibodies has been proposed as a method of localization. In one study, this scan had a sensitivity of 79% and specificity of 82% compared to echocardiography, which had a sensitivity of 88% and specificity of 97%. However, the combination of echocardiography and immunoscintigraphy has a sensitivity of 100% and specificity of 82%.

Some recent studies have shown potential clinical value of fluorine-18-2-fluoro-2-deoxy-D-glucose positron emission tomography (FDG-PET)/CT in infective endocarditis. One study showed that FDG-PET/CT detected clinically unsuspected sites of extracardiac infection in up to 24% of cases. In cases where TTE and TEE were normal or equivocal, 2 studies showed that FDG-PET/CT was able to detect periprosthetic abscesses. This situation has been shown to occur in nearly 30% of cases. A larger prospective study with 72 patients showed that adding abnormal FDG uptake around a prosthetic valve to the modified Duke criteria at admission increased the sensitivity for the diagnosis of prosthetic valve endocarditis to 97% from 70%. However, when looking at a cohort of patients with native and prosthetic valves, one study showed a relatively low sensitivity of 39% for the diagnosis of infectious endocarditis. Although early data for the use of FDG-PET/CT in the diagnosis of infectious endocarditis are encouraging, particularly in patients with prosthetic valves, further studies are needed to firmly establish the role of FDG-PET/CT in the imaging evaluation of infective endocarditis.

Magnetic Resonance Imaging (MRI)

MRI may be indicated in some instances for the evaluation of infective endocarditis. However, its use is primarily for evaluation of complications such as paravalvular and myocardial abscesses and infectious pseudoaneurysms. It is less accurate than TTE and TEE for identifying valvular vegetations. Cine MRI and velocity-encoded cine MRI can be used for quantifying the volume of valvular regurgitation. Contrast material may not be necessary but can be helpful for evaluation of abscesses.

Computed Tomography (CT)

There is limited evidence in the literature for routine use of CT for assessing patients with suspected endocarditis. CT is less accurate than TTE and TEE for identifying valvular vegetation. Consequently, the primary role of CT, like MRI, is in evaluating complications of infective endocarditis.

Routine non-electrocardiogram (ECG)-gated CT chest with contrast may have difficulties identifying vascular complications such as paravalvular abscess due to cardiac motion artifacts. Noncontrast CT chest is even less helpful given that vascular structures will not be opacified. However, routine CT chest can be helpful in right-sided endocarditis for demonstrating septic pulmonary infarcts and abscesses.

With the development of retrospectively ECG-gated multidetector-row CT (CT heart function and morphology with contrast) the identification of paravalvular and myocardial abscesses and infective pseudoaneurysms can be possible. In depicting aortic valve pseudoaneurysms, one study showed a sensitivity, specificity, positive predictive value, and negative predictive value of 100%, 87.5%, 91.7%, and 100%, respectively. The primary weakness of CT is in detecting aortic valve vegetations <1 cm in size for which the negative predictive value was 55.5%. However, the sensitivity, specificity, positive predictive value, and negative predictive value were all 100% for vegetations >1 cm in size. In addition, CT may assist in the assessment of prosthetic valve leaflets to evaluate leaflet pannus, thrombus, or other reasons for prosthesis failure.

Coronary CT angiography (CCTA) may also have a role in preoperative planning and exclusion of coronary artery disease before surgery, where the risks of selective coronary angiography may be considerable. Given the well-established high negative predictive value of CCTA, its use for the presurgical exclusion of significant coronary artery disease allows for a noninvasive alternative to cardiac catheterization. However, one limitation is that patients with endocarditis have a higher heart rate, which may limit the accuracy of coronary CTA.

Recent advances in cardiac CT imaging technology allow for further radiation dose reduction in CCTA examinations; new and available dose-reducing techniques include prospective triggering, adaptive statistical iterative reconstruction, and high-pitch spiral acquisition. However, these newer low-dose techniques may not be the appropriate in all patients due to their dependency on a combination of factors, including heart rate, rhythm, and large body size. Thus, although these techniques are promising in terms of reducing patient radiation dose, there may be patients for whom these radiation dose techniques are not optimal, such as an obese, elderly patient with an arrhythmia who might best benefit from retrospective gating in order to allow assessment of the coronary arteries at multiple phases of the cardiac cycle. In addition, not all scanners are capable of all radiation dose reduction techniques. In all cases, the imaging physician must select the appropriate combination of imaging parameters to acquire a diagnostic examination at a radiation dose that is as low as reasonably achievable (ALARA).

Catheterization and Ventricular Angiography

Catheterization and ventriculography have limited roles in the setting of infective endocarditis with congestive heart failure. It may be used to assess

the severity of valvular dysfunction and ventricular function prior to surgery, although the role of these invasive tests in the setting of infective endocarditis is not formally defined. The primary indication is for presurgical evaluation of coronaries. These tests are not indicated for patients with uncomplicated endocarditis on native valves in whom surgical intervention is not contemplated. Catheterization and ventriculography may be indicated for endocarditis of prosthetic valves when echocardiographic results are equivocal or in the evaluation of suspected mycotic aneurysms.

Cardiac Fluoroscopy

In rare occasions, cardiac fluoroscopy may be indicated for evaluating prosthetic cardiac valves afflicted with endocarditis. Valve fluoroscopy is used to detect excess mobility of the prosthetic valve during the cardiac cycle (a finding highly suggestive of valve dehiscence caused by infective endocarditis), or to detect immobility of prosthetic valve leaflets secondary to infected pannus or thrombus. More recently, ECG-gated CTA focusing on the prosthetic valve has come to replace this modality.

Summary

- In most clinical scenarios, ultrasound echocardiography using transthoracic or transesophageal technique is the most appropriate strategy for the initial evaluation and surveillance of patients with suspected infective endocarditis.
- The chest radiograph remains one of the most appropriate cornerstones for determining the severity of the hemodynamic consequences of infective endocarditis and to assess patients' response to treatment.
- Cardiac MRI may be appropriate in the evaluation of infective endocarditis, mainly in the setting of suspected complications and for quantifying the volume of valvular regurgitation.
- Cardiac CT has emerged as a probably appropriate tool for evaluating infective endocarditis, mainly in the settings of suspected complications, for evaluating prosthetic heart valves, and for preoperative planning and exclusion of coronary artery disease before surgery.
- Radioisotope scanning for identifying and localizing infected vegetations and paravalvular abscesses can be considered in rare instances, but it has been largely replaced in clinical practice by cross-sectional imaging modalities.
- In rare instances, cardiac fluoroscopy may be considered for evaluating prosthetic cardiac valves afflicted with endocarditis, but it has been largely replaced in clinical practice by cross-sectional imaging modalities, mainly cardiac CT.

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (i.e., <30 mL/min/1.73 m^2), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73 m^2. For more information, please see the American College of Radiology (ACR) Manual on Contrast Media (see the "Availability of Companion Documents" field).

Abbreviations

- CT, computed tomography
- CTA, computed tomography angiography
- ECG, electrocardiogram
- FDG-PET, fluorine-18-2-fluoro-2-deoxy-D-glucose positron emission tomography
- In-111 WBC, indium-111-labeled white blood cells
- MRI, magnetic resonance imaging
- US, ultrasound

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
	<0.1 mSv	<0.03 mSv
	0.1-1 mSv	0.03-0.3 mSv

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
	1-10 mSv 10-30 mSv	0.3-3 mSv 3-10 mSv
	30-100 mSv	10-30 mSv
*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."		

Clinical Algorithm(s)

Algorithms were not developed from criteria guidelines.

Scope

Disease/Condition(s)

Infective endocarditis

Guideline Category

Diagnosis

Evaluation

Clinical Specialty

Cardiology

Family Practice

Internal Medicine

Nuclear Medicine

Radiology

Intended Users

Health Plans

Hospitals

Managed Care Organizations

Physicians

Utilization Management

Guideline Objective(s)

To evaluate the appropriateness of radiologic examinations for patients with suspected infective endocarditis

Target Population

Patients with suspected infective endocarditis

Interventions and Practices Considered

1. X-ray chest
2. Ultrasound (US) echocardiography
    - Transesophageal
    - Transthoracic (resting)
3. Magnetic resonance imaging (MRI) heart function and morphology
    - Without contrast
    - Without and with contrast
4. Computed tomography (CT)
    - Heart function and morphology with contrast
    - Without and with contrast
    - With contrast
    - Without contrast
5. CT angiography (CTA) coronary arteries with contrast
6. Indium-111-labeled white blood cell (In-111 WBC) scan heart
7. Coronary arteriography with ventriculography
8. Fluorine-18-2-fluoro-2-deoxy-D-glucose positron emission tomography (FDG-PET)/CT skull base to mid-thigh
9. Fluoroscopy heart

Major Outcomes Considered

- Utility of radiologic examinations in differential diagnosis
- Sensitivity, specificity, and positive predictive value of radiologic examinations

Methodology

Methods Used to Collect/Select the Evidence

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Literature Search Procedure

Staff search in PubMed only for peer reviewed medical literature for routine searches. Any article or guideline may be used by the author in the narrative but those materials may have been identified outside of the routine literature search process.

The Medline literature search is based on keywords provided by the topic author. The two general classes of keywords are those related to the condition (e.g., ankle pain, fever) and those that describe the diagnostic or therapeutic intervention of interest (e.g., mammography, MRI).

The search terms and parameters are manipulated to produce the most relevant, current evidence to address the American College of Radiology Appropriateness Criteria (ACR AC) topic being reviewed or developed. Combining the clinical conditions and diagnostic modalities or therapeutic procedures narrows the search to be relevant to the topic. Exploding the term "diagnostic imaging" captures relevant results for diagnostic topics.

The following criteria/limits are used in the searches.

1. Articles that have abstracts available and are concerned with humans.
2. Restrict the search to the year prior to the last topic update or in some cases the author of the topic may specify which year range to use in

the search. For new topics, the year range is restricted to the last 10 years unless the topic author provides other instructions.
3. May restrict the search to Adults only or Pediatrics only.
4. Articles consisting of only summaries or case reports are often excluded from final results.

The search strategy may be revised to improve the output as needed.

Number of Source Documents

The total number of source documents identified as the result of the literature search is not known.

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Study Quality Category Definitions

Category 1 - The study is well-designed and accounts for common biases.

Category 2 - The study is moderately well-designed and accounts for most common biases.

Category 3 - There are important study design limitations.

Category 4 - The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:

a. The study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description).
b. The study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence.
c. The study is an expert opinion or consensus document.

Methods Used to Analyze the Evidence

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

The topic author drafts or revises the narrative text summarizing the evidence found in the literature. American College of Radiology (ACR) staff draft an evidence table based on the analysis of the selected literature. These tables rate the strength of the evidence (study quality) for each article included in the narrative text.

The expert panel reviews the narrative text, evidence table, and the supporting literature for each of the topic-variant combinations and assigns an appropriateness rating for each procedure listed in the table. Each individual panel member assigns a rating based on his/her interpretation of the available evidence.

More information about the evidence table development process can be found in the ACR Appropriateness Criteria® Evidence Table Development document (see the "Availability of Companion Documents" field).

Methods Used to Formulate the Recommendations

Expert Consensus (Delphi)

Description of Methods Used to Formulate the Recommendations

Rating Appropriateness

The appropriateness ratings for each of the procedures included in the Appropriateness Criteria topics are determined using a modified Delphi methodology. A series of surveys are conducted to elicit each panelist's expert interpretation of the evidence, based on the available data, regarding the appropriateness of an imaging or therapeutic procedure for a specific clinical scenario. American College of Radiology (ACR) staff distributes surveys to the panelists along with the evidence table and narrative. Each panelist interprets the available evidence and rates each procedure. The surveys are completed by panelists without consulting other panelists. The appropriateness rating scale is an ordinal scale that uses integers from 1 to 9 grouped into three categories: 1, 2, or 3 are in the category "usually not appropriate"; 4, 5, or 6 are in the category "may be appropriate"; and 7, 8, or 9 are in the category "usually appropriate." Each panel member assigns one rating for each procedure for a clinical scenario. The ratings assigned by each panel member are presented in a table displaying the frequency distribution of the ratings without identifying which members provided any particular rating.

If consensus is reached, the median rating is assigned as the panel's final recommendation/rating. Consensus is defined as eighty percent (80%) agreement within a rating category. A maximum of three rounds may be conducted to reach consensus. Consensus among the panel members must be achieved to determine the final rating for each procedure.

If consensus is not reached, the panel is convened by conference call. The strengths and weaknesses of each imaging procedure that has not reached consensus are discussed and a final rating is proposed. If the panelists on the call agree, the rating is proposed as the panel's consensus. The document is circulated to all the panelists to make the final determination. If consensus cannot be reached on the call or when the document is circulated, "No consensus" appears in the rating column and the reasons for this decision are added to the comment sections.

This modified Delphi method enables each panelist to express individual interpretations of the evidence and his or her expert opinion without excessive influence from fellow panelists in a simple, standardized and economical process. A more detailed explanation of the complete process can be found in additional methodology documents found on the ACR Web site (see also the "Availability of Companion Documents" field).

Rating Scheme for the Strength of the Recommendations

Not applicable

Cost Analysis

Transthoracic echocardiography (TTE) was found to be the more cost effective test in patients with intermediate or high pretest probability of infective endocarditis.

Method of Guideline Validation

Internal Peer Review

Description of Method of Guideline Validation

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The recommendations are based on analysis of the current literature and expert panel consensus.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Selection of appropriate radiologic imaging procedures for evaluation of patients with suspected infective endocarditis

Potential Harms

Gadolinium-Based Contrast Agents

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (i.e., <30 mL/min/1.73 m^2), and almost never in other patients. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73 m^2. For more information, please see the American College of Radiology (ACR) Manual on Contrast Media (see the "Availability of Companion Documents" field).

Relative Radiation Level

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document (see the "Availability of Companion Documents" field).

Qualifying Statements

Qualifying Statements

The American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

IOM Domain

Effectiveness

Identifying Information and Availability

Bibliographic Source(s)

Hsu JY, Malik SB, Abbara S, Akers SR, Araoz PA, Cummings KW, Cury RC, Dorbala S, Earls JP, Hoffmann U, Jacobs JE, Min JK, Woodard PK, Expert Panel on Cardiac Imaging. ACR Appropriateness CriteriaÂ® suspected infective endocarditis [online publication]. Reston (VA): American College of Radiology (ACR); 2014. 8 p. [42 references]

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

1998 (revised 2014)

Guideline Developer(s)

American College of Radiology - Medical Specialty Society

Source(s) of Funding

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

Guideline Committee

Committee on Appropriateness Criteria, Expert Panel on Cardiac Imaging

Composition of Group That Authored the Guideline

Panel Members: Joe Y. Hsu, MD (*Principal Author*); Sachin B. Malik, MD (*Research Author*); Suhny Abbara, MD (*Panel Vice-chair*); Scott R. Akers, MD; Philip A. Araoz, MD; Kristopher W. Cummings, MD; Ricardo C. Cury, MD; Sharmila Dorbala, MD; James P. Earls, MD; Udo Hoffmann, MD, MPH; Jill E. Jacobs, MD; James K. Min, MD; Pamela K. Woodard, MD (*Panel Chair*)

Financial Disclosures/Conflicts of Interest

Not stated

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Schoepf UJ, White RD, Woodard PK, Carr JJ, Dorbala S, Earls JP, Hendel RC, Ho VB, Hoffman U, Mammen L, Ryan T, White CS, Expert Panel on Cardiac Imaging. ACR Appropriateness Criteria® suspected infective endocarditis. [online publication]. Reston (VA): American College of Radiology (ACR); 2011. 6 p. [48 references]

Guideline Availability

Electronic copies: Available from the American College of Radiology (ACR) Web site .

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

Availability of Companion Documents

The following are available:

- ACR Appropriateness Criteria®. Overview. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Electronic copies: Available from the American College of Radiology (ACR) Web site .
- ACR Appropriateness Criteria®. Literature search process. Reston (VA): American College of Radiology; 2013 Apr. 1 p. Electronic copies: Available from the ACR Web site .
- ACR Appropriateness Criteria®. Evidence table development – diagnostic studies. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Electronic copies: Available from the ACR Web site .
- ACR Appropriateness Criteria®. Radiation dose assessment introduction. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Electronic copies: Available from the ACR Web site .
- ACR Appropriateness Criteria®. Manual on contrast media. Reston (VA): American College of Radiology; 90 p. Electronic copies: Available from the ACR Web site .
- ACR Appropriateness Criteria®. Procedure information. Reston (VA): American College of Radiology; 2013 Apr. 1 p. Electronic copies: Available from the ACR Web site .
- ACR Appropriateness Criteria® suspected infective endocarditis. Evidence table. Reston (VA): American College of Radiology; 2014. 15 p. Electronic copies: Available from the ACR Web site .

Patient Resources

None available

NGC Status

This summary was completed by ECRI on February 20, 2001. The information was verified by the guideline developer on March 14, 2001. This summary was updated by ECRI Institute on August 11, 2006, June 27, 2011, and July 16, 2014.

Copyright Statement

Disclaimer

NGC Disclaimer

The National Guideline Clearinghouseâ„¢ (NGC) does not develop, produce, approve, or endorse the guidelines represented on this site.

All guidelines summarized by NGC and hosted on our site are produced under the auspices of medical specialty societies, relevant professional associations, public or private organizations, other government agencies, health care organizations or plans, and similar entities.

Guidelines represented on the NGC Web site are submitted by guideline developers, and are screened solely to determine that they meet the NGC Inclusion Criteria which may be found at http://www.guideline.gov/about/inclusion-criteria.aspx.

NGC, AHRQ, and its contractor ECRI Institute make no warranties concerning the content or clinical efficacy or effectiveness of the clinical practice guidelines and related materials represented on this site. Moreover, the views and opinions of developers or authors of guidelines represented on this site do not necessarily state or reflect those of NGC, AHRQ, or its contractor ECRI Institute, and inclusion or hosting of guidelines in NGC may not be used for advertising or commercial endorsement purposes.

Readers with questions regarding guideline content are directed to contact the guideline developer.